of record, independent claims 24 and 29 have been amended to be in dependent form. Moreover, the dependent claims which depend upon independent claims 24 and 29 have been canceled. Therefore, upon entry of the present amendment, the number of independent claims will be reduced from three to one, i.e., claim 19 will be the sole independent claim. Moreover, claims 24 and 29 have been amended to avoid claim redundancy.

Applicants respectfully submit that entry of this amendment after final rejection is appropriate, because it seeks to place the application into allowable form, it seeks to reduce the number of issues, and it should not be considered to raise new issues or introduce new matter. Still further, even if the application is not considered to be in allowable form, the amendment reduces the number of issues for appeal.

Reconsideration and allowance of the application are respectfully requested.

Response To Formal Matters

Applicants express appreciation for the acknowledgment of the claim of priority as well as receipt of all of the certified copies in this national stage application.

Applicants also express appreciation for the inclusion in the Office Action of the initialed copy of the Form PTO-1449 submitted with the Supplemental Information Disclosure Statement filed April 4, 2003, whereby the Examiner's consideration of the disclosure statement is of record.

Response To 35 U.S.C. 103(a) Rejections

Applicants note that the following rejections are set forth in the Final Office Action:

(1) Claims 19-21 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11-040330 (hereinafter "Masakazu") in view of JP 11-251040 (hereinafter "Kiyoshi"). The rejection alleges that Masakazu discloses a ceramic heater with a substrate made of a carbide or nitride ceramic with a thickness of 0.5-5 mm and a resistance heating body formed of a plurality of circuits on a face of the substrate opposite to the heating face. The rejection admits that Masakazu does not disclose the scattering of thickness of the resistance heating body to be less than 50%. However, the rejection alleges that Kiyoshi discloses a similar ceramic heater and discloses resistance body thickness dispersion of less than 10%. The rejection concludes that it would have been obvious to keep the thickness dispersion as small as possible so as to have uniform temperature at the heating face.

(2) Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Masakazu in view of Kiyoshi, and further in view of U.S. Patent No. 5,591,269 to Arami et al. (hereinafter "Arami"). The rejection admits that Masakazu does not disclose the resistance heating body formed on the insulating layer. However, the rejection alleges that Arami discloses a resistance heating body formed on an insulating layer. The rejection concludes that it would have been obvious to provide a heating resistance body on top of insulating layer so as not to have short circuiting, especially at high temperature when the resistance of the ceramic base gets low.

(3) Claims 24-26, 28-31 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Masakazu in view of Kiyoshi, and further in view of JP 07307377 (hereinafter

"Kawada"). Regarding claims 24-26 and 28, the rejection alleges that Masakazu and Kiyoshi disclose all the recitations of these claims but admits that they do not disclose that the surface roughness of the resistive heating body is to be 0.05-100 μm. However, the rejection alleges that Kawada discloses a surface roughness of a heating layer on a ceramic heater being greater than 5 μm. Regarding claims 29-31 and 33, the rejection alleges that Masakazu and Kiyoshi disclose all the recitations except that they do not disclose that the surface roughness of the heating body is less than 50% of its average thickness. However, the rejection alleges that Masakazu discloses the average thickness of the resistance body to be 1-20 μm and with a 50% maximum, the roughness may be 0.5-10 μm. The rejection further alleges that this falls within acceptable disclosed level of roughness in the claim as well as in Kawada.

(4) Claims 27 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Masakazu in view of Kiyoshi and Kawada, and further in view of Arami, U.S. Patent No. 5,591,269. The rejection admits that Masakazu does not disclose the resistance heating body formed on the insulting layer but alleges that Arami discloses a resistance-heating body formed on an insulting layer. The rejection concludes that it would have been obvious to provide heating resistance body on top of insulating layer so as not have short circuiting specially at high temperature when the resistance of the ceramic base gets low.

In response, Applicants once again respectfully submit that independent claim 19 is directed a ceramic heater comprising a ceramic substrate and a resistance heating body formed on a surface thereof, wherein the resistance heating body is formed on a face of the ceramic substrate opposite to a heating face thereof and a scattering of a thickness of the resistance heating body is within a range of ±50% of an average thickness.

Thus, amongst the features recited in independent claim 19, the claim is directed to a resistance heating body which is formed on a face of the ceramic substrate opposite to a heating face thereof, whereby the distance between the heating body and the heating face can be sufficiently ensured. Therefore, heat produced from the heating body can be transmitted and diffused into the ceramic substrate to improve the temperature uniformity of the heating face. However, Applicants have confirmed that a non-uniform portion may be existent in the heating face. As a result of the analysis on this phenomenon, it has been found that a scattering in the thickness of the resistance heating body is caused and hence the scattering in the resistance value is caused to produce different heat generating amounts in places of the heating body.

Also, amongst the features recited in independent claim 19, it is recited that scattering of a thickness of the resistance heating body is within a range of ± 50% of an average thickness. This combination of features enables the heat generating amount to be made more uniform by adjusting the scattering of the thickness of the heating body itself to ± 50% of an average thickness, so that the temperature uniformity of the heating face can be further improved.

To further understand this aspect of Applicants' invention, attention is once again directed to Example 1 and Comparative Examples 1 and 4. Comparative Example 1 is an experimental

example, which as will be discussed in further detail below when discussing Masakazu, corresponds to Masakazu in that Solvest is adopted as a conductive paste.

The scattering of thickness in Comparative Example 1 is 55%, while those of Examples 1 and 4 are 15% and 40%, respectively. Also, the scattering of temperature in the heating face is 10°C in Comparative Example 1, 5°C in Example 1, and 6°C in Example 4, respectively. Therefore, Examples 1 and 4 are superior to Comparative Example 1.

Comparative Example 4 is concerned with an inner layer heater, in which the scattering of temperature is 13°C, which is inferior to Examples 1 and 4. In the inner layer heater as described in comparative Example 4, the distance between the heating body and the heating face is short, so that. a high temperature zone similar to the pattern of the heating body is apt to be easily produced in the heating face.

Thus, the present invention solves the problem inherent to the invention of Masakazu, and is not taught or suggested by Masakazu.

Moreover, in the present invention, it is preferred that the surface roughness of the resistance heating body is in a range of 0.05-100 μm as Rmax. When the surface roughness is less than 0.05 μm, atmospheric gas is too fluidized to take heat and hence the drop of temperature is caused, while when it exceeds 100 μm, the scattering of thickness in the heating body becomes large and non-uniformity of temperature in the heating face is caused.

This is understood from a comparison of Examples 1 and 4 with Comparative Examples 2 and 3 as disclosed in the present specification. In this regard, Rmax of the heating body is 0.5 μm in Example 1 and 3.5 in Example 4, and 130 μm in Comparative Example 2 and 0.04 μm in

Comparative Example 3, respectively. Hence, the scattering of temperature in the heating body is 5°C in Example 1, 6°C in Example 4, 15°C in Comparative Example 2, and 10°C in Comparative Example 3, respectively. From these results, it is clear that the scattering of temperature in the heating face is controlled in Examples 1 and 4.

Moreover, as mentioned above, the present invention further improves the uniformity of temperature in the heating face by adjusting the surface roughness of the resistance heating body in addition to the adjustment of scattering of the thickness of the heating body itself to ± 50% of an average thickness.

Masakazu discloses a heater in which a heating body form by sintering metallic particles is arranged on a plate body of nitride ceramic or carbide ceramic, and also discloses printing of a conductor paste on the plate-shaped ceramic and heating. Howver, Masakazu does not disclose adjusting the thickness of the heating body and surface roughness. Therefore the scattering of the thickness of the heating body exceeds 50% in Masakazu as will be discussed in more detail below.

In particular, as discussed on page 15, lines 22-27 of Applicants' specification, even when the conductor paste is printed on the ceramic substrate as it is, the scattering of the thickness exceeds 50% of the average thickness.

Expanding upon the above, it is noted that Solvest PS603 is used as a conductor paste in Comparative Example 1 disclosed in the present application as well as in Example 1 of Masakazu. Moreover, the ceramic is printed as it is without adjusting the thickness and surface roughness in Comparative Example 1 and Example 1 of Masakazu, whereby Masakazu

corresponds to Comparative Example 1. Therefore, Masazaku includes a scattering of the thickness of more than 50%. In this regard, the scattering measured in Comparative Example 1 is 55%, and this is different from the present invention. Also, because a large scattering exist, the temperature uniformity of the heating face of Masakazu is inferior to the presently claimed invention as discussed above.

From the above, it is apparent that the present invention solves the problem inherent to the invention disclosed in Masakazu and there is no teaching or suggestion to arrive at Applicants' invention from Masazaku, especially when Masazaku does not teach or suggest the problem and/or any solution thereof.

The deficiencies of Masazaku are not overcome by the remaining documents utilized in the rejections.

Kiyoshi is concerned with the inner layer heater, which corresponds to Comparative Example 4. Therefore, Kiyoshi is entirely different from the present invention. There is no suggestion or motivation to employ the element on the surface with the scattering of the thickness of the resistance heating body of Masakazu, which is on the top of the heater, much less to employ the range as recited in the present claims.

Expanding upon the above, Applicants note that Kiyoshi discloses a ceramic heater wherein a difference between maximum value and minimum value in the thickness of each tape-shaped resistance heating body appears in a section cut by at least two line segments passing through substantially a center point of a heating pattern region constructed with the resistance heating elements is within 10% of an average value of the thicknesses of the resistance heating

elements appearing at the total cut section. This heater, however, is an embedded type heater, which is entirely different from the ceramic heater according the present invention in which the resistance heating body is formed on the surface of the ceramic substrate.

Kiyoshi discloses in paragraph [0001] that the ceramic heater is used, for example, as a heater for ignition of various combustion machines and a heater for heating various heating machines or measuring devices, particularly as a heater for heating semiconductor wafer used for film forming apparatus such as plasma CVD, reduced CVD, photo-CVD, PVD and the like or etching apparatus such as plasma etching, photoetching and the like in the production of semiconductor devices. In other words, the heater of Kiyoshi is a heater used for plasma CVD apparatus. In such a heater, the resistance heating element should be embedded in the ceramic substrate because the metal would be corroded under a plasma environment. Thus, following Kiyoshi one having ordinary skill in the art would not be motivated to form the heating element on the surface of the ceramic substrate because it is corroded by plasma.

Further, the heater of Kiyoshi corresponds to Comparative Example 4 disclosed in Applicants' specification. As noted above, the embedded type heater is short in distance between the heating body and the heating face and a high temperature region similar to the heating body pattern is apt to be caused in the heating face, so that temperature uniformity of the heating face is inferior to that associated with the present invention. In fact, the temperature scattering is 5°C in Example 1 as compared to 13°C in Comparative Example 4.

Applicants therefore respectfully submit that one having ordinary skill in the art would not have been motivated to combined the disclosures of Masazaku and Kiyoshi. Moreover, even

if for the sake of argument, the disclosures were combined, the presently claimed invention would not be at hand.

Arami discloses a technique that the insulating layer 23 is formed in the substrate 22 of ceramic such as BN and the heating body 26 is further formed thereon. However, Arami does not teach nor suggest any control of thickness scattering of the heating body.

Arami discloses at column 24, lines 55 to 65 that the heater 26 is wired by CVD (chemical vapor deposition) process. Since CVD process is a technique wherein the starting gas is subjected to chemical reaction treatment such as thermal decomposition to deposit the resulting reaction product, it is impossible to control the average thickness of the thickness scattering to not more than 50% unless the thickness is controlled after the deposition. In Arami, the control of the thickness is not conducted after the formation of the heating body through CVD process, so that the temperature uniformity of the heating face is poor as compared with that of the present invention.

Kawada discloses a ceramic heater provided with an electrostatic chuck wherein an electrode for electrostatic chuck made of an electrically conductive ceramic is joined onto a front surface of a support substrate made of an electrically insulative ceramic and a heating layer made of an electrically conductive ceramic is joined onto a rear surface thereof and further a coating layer made of an electrically insulative ceramic is formed thereon provided that surface roughness Rmax of each of the support substrate, electrode and heating layer is not less than 5 μm. As described in [0005], the reason why the surface roughness Rmax is limited to not less than 5 μm is due to the fact that is it desired to improve the adhesion property between the

heating layer and the coating layer, which is different from the temperature uniformity of the heating face.

Moreover, Kawada does not teach nor suggest any control of thickness scattering of the heating layer.

Still further, Kawada discloses in claim 3 that the heating layer is formed by chemical vapor deposition process such as in Arami.

Therefore, it is seen that the documents utilized in the rejections of record do not teach or suggest a ceramic heater comprising a ceramic substrate and a resistance heating body formed on a surface thereof, wherein the resistance heating body is formed on a face of the ceramic substrate opposite to a heating face thereof and a scattering of a thickness of the resistance heating body is within a range of ±50% of an average thickness.

Moreover, the documents utilized in the rejections do not teach or suggest, as recited in dependent claim 20, a ceramic heater according to claim 19, wherein the ceramic substrate is a carbide or nitride ceramic.

Still further, the documents utilized in the rejections do not teach or suggest, as recited in dependent claim 21, a ceramic heater according to claim 19, wherein the ceramic substrate has a thickness of not more than 25 mm.

Still further, the documents utilized in the rejections do not teach or suggest, as recited in dependent claim 22, a ceramic heater according to claim 19, wherein an insulating layer of an oxide ceramic is formed on the surface of the ceramic substrate and the resistance heating body is formed on a surface of the insulating layer.

Still further, the documents utilized in the rejections do not teach or suggest, as recited in dependent claim 23, a ceramic heater according to claim 19, wherein the resistance heating body is constructed by two or more circuits.

Still further, the documents utilized in the rejections do not teach or suggest, as recited in dependent claim 24, a ceramic heater according to claim 19, wherein a surface roughness of the resistance heating body is within a range of 0.05 μm - 100 μm as Rmax.

Still further, the documents utilized in the rejections do not teach or suggest, as recited in dependent claim 2, a ceramic heater according to claim 19, wherein a surface roughness of the resistance heating body is within a range of 0.05 μm - 100 μm as Rmax and not more than 50% of an average thickness of the resistance heating body.

Accordingly, Applicants respectfully submit that the prior art of record does not teach nor suggest Applicants' disclosed and claimed invention, whereby the rejections should be withdrawn, and each of the claims indicated to be allowable.

CONCLUSION

In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw the rejection of record, and allow each of the pending claims.

Applicant therefore respectfully requests that an early indication of allowance of the application be indicated by the mailing of the Notices of Allowance and Allowability.

Should the Examiner have any questions regarding this Response, the this application, the Examiner is invited to contact the undersigned at the below-listed telephone number.

Respectfully submitted,
Yasuji HIRAMATSU et al.

Bruce H. Bernstein
Reg. No. 29,027

November 6, 2003
GREENBLUM & BERNSTEIN, P.L.C.
1950 Roland Clarke Place
Reston, VA 20191
(703) 716-1191